seen at all. A very feeble light is sufficient to illuminate the wires perfectly for any object. I believe far better results can be obtained by the use of bright wires in a large part of the most desirable and important double-star work, than is possible by the same observer using a bright field, and that sooner or later it will be generally used in all micrometrical observations.

Chicago:
1882, *February* 25.

The Transit of Mercury, 1881, *November* 7, *observed in New South Wales.*

(*Communicated by H. C. Russell, Esq., Government Astronomer, Sydney.*)

In order to secure satisfactory observations of the Transit of *Mercury* the observers were divided into three parties: two, Mr. Lenehan, first assistant in the Observatory, and myself, observed at Sydney, using respectively $7\frac{1}{4}$-inch and $11\frac{1}{2}$-inch Refractors, both stopped to 6 inches. At Katoomba, a place on the Western Railway, 66 miles west of Sydney, and 3,400 feet above the sea level, Messrs. Hargrave and Bladen, assistants in the Observatory, observed; the former using a $4\frac{3}{4}$-inch Troughton & Simms equatoreally-mounted Refractor, and the latter a $4\frac{1}{4}$-inch Cooke Equatoreal, both driven by clock-work. At Bathurst, on the elevated table land, 2,300 feet above the sea and 134 miles by rail west of Sydney, the observers were Mr. Conder, chief of the Trigonometrical Branch of the Survey Department, and Mr. Brooks, on the Trigonometrical Survey staff; the former used a $4\frac{3}{4}$-inch Schroeder Equatoreal, and the latter a $3\frac{3}{4}$-inch Troughton & Simms.

The morning was fine and clear, but the definition in Sydney was very bad; on the high lands it was better. At Egress, the definition in Sydney was steadier, but a thick cirrus haze covered the sky; the conditions were similar at the inland stations, only the definition got worse instead of better.

The times given are all in Sydney mean time, and corrected for clock errors, but not for the positions of the observers. The following extracts from the observers' Reports will show the phenomena observed:—

Mr. Russell: "For *Ingress*, used $7\frac{1}{4}$-inch Merz Refractor, power 150.

"Air clear, but very unsteady. $8^h\ 21^m\ 34^s{\cdot}64$, thought I saw notch in Sun's limb, but lost it. $8^h\ 21^m\ 44^s{\cdot}64$, first contact certain. $8^h\ 23^m\ 5^s$, *Mercury* assumed a D shape; Sun's limb boiling, and *Mercury* seems to jump half its diameter. $8^h\ 23^m\ 39^s{\cdot}14$, observed unsatisfactory contact—unsatisfactory, because of the vibration and tremulous definition, and that, for ten seconds be-

fore, contact of limbs was made and broken several times over. From this time I used 11½-inch Schroeder Refractor, stopped to 6 inches, polarising eyepiece, no coloured glass, powers 100 to 200, made of quartz. In moments of best definition, see clearly the black specks in the mottling on the Sun's surface. *Mercury* intensely blue-black; no sign of satellite, and no halo of any kind visible round the planet; when definition gets bad, as it does periodically, *Mercury* loses the blackness, and looks like a black ball shaded with white, the darkest part of the shading being near the planet's limb; thence, shading off to nothing before it reaches the centre, it extends half-way round the planet on the preceding side; I see no white spot in the centre. *Egress*: Definition steadier, but very thick haze. At $1^h\ 40^m\ 55^s$, Sun very unsteady, a shade or dark band connected the limbs, then broke; this was repeated several times in as many seconds, and then ceasing left a clear band of light between the limbs. Definition steady, band of light got gradually narrower, and broke at $1^h\ 40^m\ 26^s{\cdot}65$; ten seconds later planet elongated. Clouds thick, obliged to turn polarising eyepiece to admit all the light it would; last contact observed at $1^h\ 42^m\ 8^s{\cdot}95$. Nothing seen of the planet after this; haze too thick."

Mr. Lenehan: "*Ingress* observed through 3-inch Refractor, hurriedly placed in position and moved by hand-screw. First indent, $8^h\ 22^m\ 8^s$. Planet moved steadily and clearly on towards internal contact, which was observed at $8^h\ 23^m\ 43^s$. Observations now made with 7¼-inch Merz, stopped to 6 inches. At $8^h\ 5^m$ an apparent halo round planet. $9^h\ 6^m$, halo still visible. $9^h\ 50^m$, disk of planet sharp, without marginal indistinctness or halo; no appearance of any satellite; clouds about. $10^h\ 50^m$, clear disk, halo not discernible. *Egress*: $1^h\ 10^m$, definition bad, with marginal indistinctness. First contact at Egress, $1^h 40^m\ 29^s{\cdot}25$; no absolute certainty in the actual time, as the definition was not good and the wind high, causing vibration in the telescope, but I am satisfied with the time given. External contact occurred under same conditions at $1^h\ 42^m\ 4^s{\cdot}25$."

Dr. Wright obtained time from the Observatory, and observed with his own 8½-inch Reflector: for Ingress stopped to 5 inches, power 80; for Egress stopped to 7½ inches. Browning's double-prism solar eyepiece used.

Mr. Morrice used his own 8½-inch Browning-With Reflector; obtained time from the Observatory, and observed in the suburbs of Sydney.

KATOOMBA.

Mr. Hargrave: "Weather all that could be wished. Used full aperture, 4¾ inches; power 100; darkest glass shade. Definition very good. Saw first contact at $8^h\ 22^m\ 0^s{\cdot}66$, Sydney mean

time. Planet three-quarters on, cusps slightly rounded, but it did not last until second contact, when the definition was very good and quite calm. At $8^h\ 23^m\ 41^s{\cdot}38$, there is an optical illusion like a spot of light in the centre of *Mercury*, which disappears on looking steadfastly at it; the limb of *Mercury* is a hard line, no colour or difference of light on the Sun at the planet's limb. $8^h\ 43^m$, cirrus clouds about. $9^h\ 21^m$, tried high power—definition bad, it is shaky with low one too; reduced aperture to 2 inches —much better definition. White spot still dancing about the middle of *Mercury*; blackness of planet more intense than that of Sunspot. $12^h\ 25^m$, white spot very persistent. $1^h\ 35^m$, light clouds passing. Observed internal contact at $1^h\ 40^m\ 10^s{\cdot}4$, both limbs moderately well defined, cusps sharp; last contact at $1^h\ 42^m\ 0^s{\cdot}09$."

Mr. Bladen: "Weather very clear. Used $4\frac{1}{4}$-inch Cooke Equatoreal, with clock-work, solar diagonal eyepiece, power 100; object-glass stopped to 2 inches. Definition very good indeed. First contact, slight indent, at $8^h\ 22^m\ 3^s{\cdot}34$; outline of planet as it crept on the Sun very clear and well defined. When planet was three-quarters on, a light cirrus cloud passed, making cusp indistinct; and at $8^h\ 23^m\ 24^s{\cdot}64$, I thought, from the irregular shape of *Mercury*, that internal contact would be complete but for the bad definition. At $8^h\ 23^m\ 42^s{\cdot}84$ a band of light was visible between the limbs, and from its breadth it would doubtless have been seen two or three seconds before with better definition.

"No sign of the part off the Sun's disk could be seen during the time *Mercury* was creeping on the Sun. *Mercury* on the Sun appears a perfect sphere and intensely black, without any halo or spots, and I saw no satellite. Definition so good for an hour after Ingress that I used the highest powers, and different apertures, but I could see nothing else to note.

"*Egress*: Internal contact, $1^h\ 40^m\ 44^s{\cdot}34$. I waited before taking this time until I was quite sure contact was complete, the bad definition making it difficult to decide. The planet did not seem to move steadily off the Sun, but in a series of jumps half a second in duration, which may have lasted ten or fifteen seconds; when I was quite certain that there was no trace of the planet, I noted the time, $1^h\ 42^m\ 23^s{\cdot}64$."

BATHURST.

Mr. Conder: "I used $4\frac{3}{4}$-inch Schroeder telescope, equatoreally mounted; solar eyepiece and power 90 were used. Tried various stops, and then used full aperture of objective. Having an electric chronograph, ticks of Sydney standard clock were recorded, beside those of my chronometer, a short time before and after transit, and errors of time were thus practically eliminated.

"In early morning weather very fine, but about time of Ingress

clouds (cirrus) began to form, but definition was very good. My driving clock was not working well, so that specks of dust were made to move and caused apparent notches on the Sun's limb, and for a second or two I was in doubt, but as soon as I was certain I closed the chronograph key, and made the time $8^h\,22^m\,5^s$. Comparing mentally afterwards the distance between the cusps, I estimated this at six or seven-tenths of the planet's diameter; but as the estimate was not made at the time, it is not intended to be used. A few seconds before internal contact the telescope was accidentally touched, causing vibrations, which had scarcely ceased when the limbs of the planet and Sun appeared tangential; time by chronograph, $8^h\,23^m\,35^s{\cdot}75$. I felt in some doubt whether the cusps had really closed at this instant, and I continued to watch very carefully, and, within so small an interval as to be scarcely appreciable, an extremely fine line of light was noticed separating the planet from the Sun's limb.

"I watched the planet at intervals during its transit, the definition most of the time being magnificent. I failed to notice any peculiar appearances, except, perhaps, a very faint suspicion of a halo, or yellowish light surrounding the intensely black disk of the planet, and slightly brighter than the general illumination of the Sun's disk; this I attributed to an optical illusion.

"At Egress, clouds were so thick that I could not see the Egress through my dark glass, and I had not a second one.

"The position of the observing station, found by connection with the main triangulation, is—Lat. 33° 25′ 45″·5; Long. 149° 33′ 47″·9 East."

Mr. Brooks: "Telescope used was by Troughton & Simms, $3\frac{3}{4}$-inch aperture, and equatoreally mounted, stopped to 3 inches; solar reflecting eyepiece, and power 104, with lighter of the two coloured shades. The definition on Sunspots was very clear, and the whole of the Sun's surface had a faint mottled appearance, and the faculæ were at times very distinct. Three or four minutes before contact cirrus clouds covered the sky. I first caught sight of a decided notch in the Sun's limb at $8^h\,22^m\,3^s{\cdot}60$; the notch was quite decided before I was certain it was what I was looking for. On reflection, I think about one-tenth of the planet's disk must have been on the Sun at the time. At $8^h\,23^m\,36^s{\cdot}45$ I caught the first indication of a white line separating the Sun and planet's limbs. Just before this, the planet seemed to draw out slightly, as if unwilling to leave the Sun's limb, leaving in my mind a faint suspicion of a black drop. Three minutes after contact I saw a whitish spot on the south preceding quadrant, and an irregular white band of light inside the planet's disk. I suspect this was merely optical. About noon clouds were denser, causing the planet to lose its dead black appearance. Definition fairly steady. Ten minutes before Egress I changed the eyepiece for one marked 110, aperture and sunshade as before. At $1^h\,40^m\,26^s{\cdot}48$, I noted first internal

contact, without seeing any indication whatever of the black drop; and at $1^h\ 42^m\ 8^s{\cdot}59$ I saw the last contact; but owing to the passing clouds, there may be an uncertainty of, say, one second in first and about two seconds in last contact at Egress. Time by chronometer compared before and after transit with ticks from Sydney clock."

Observed Times of Transit of Mercury in New South Wales.

	First External Contact.	First Internal Contact.	Second Internal Contact.	Second External Contact.
	h m s	h m s	h m s	h m s
Russell	8 21 44·64	8 23 39·14	1 40 26·65	1 42 8·95
Lenehan	22 8·00	43·00	29·25	4·25
Wright	21 20·00	10·00	23·00	3·00
Morrice	22 15·00	46·00	16·00	16·00
Hargrave	22 0·66	41·38	10·40	0·09
Bladen	22 3·34	42·84	44·34	23·64
Conder	22 5·00	35·75	—	—
Brooks	22 3·60	36·45	26·48	8·59
Arithmetical Means	8 21 57·53	8 23 36·82	1 40 25·16	1 42 9·217

Observations of the Transit of Mercury, 1881, *November* 7, *made at Honolulu, Sandwich Islands.* By C. H. Rockwell, Esq.

(*Communicated by the Secretaries.*)

I send herewith a Report of my movements in connection with observations made of the Transit of *Mercury*, at Honolulu, Sandwich Islands, on November 7, 1881.

The king, Kalakaua, offered me the free occupancy of the site from which the observations of the Transit of *Venus* were made in December 1874 by the English party under command of Capt. G. L. Tupman.

This civility on the part of His Majesty saved me the trouble and expense of building a pier of mason-work on which to mount my telescope, and, being on his own private grounds, I was enabled to occupy a quiet location whose geographical position had been determined with great accuracy.

The latitude and longitude given in this Report, and used in computing the times of contact, are the results obtained by Capt. Tupman.

I built a shed of rough boards over one of the piers left by the Transit of *Venus* party; there was no roof on the slope towards the South and West, the opening being covered at night with a part of an old sail, which could be easily put in position or withdrawn.